REMARKS

Upon entry of this amendment, claims 1-5, 11 and 13-21 are all the claims pending in the application. By this amendment, claims 13-21 have been added, and claims 6-10 and 12 have been canceled. No new matter has been added.

I. Claim Rejections under 35 U.S.C. § 103(a)

A. Claims 1, 2, 4-7, and 9-11 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Kitamine et al. (U.S. 6,034,494) in view of Kawabata (U.S. 6,650,073).

Claim 1, as amended, recites that the driver controls the dc brush-less motor such that, during a start-up mode of driving the dc brush-less motor, a phase of the current of a winding of the dc brush-less motor is advanced with respect to a phase of the induction voltage generated in the winding in order to obtain sufficient torque to start driving the dc brush-less motor, and that the driver controls the dc brush-less motor such that, immediately after the start-up mode is complete, the advancement of the phase of the current of the winding with respect to the phase of the induction voltage generated in the winding is reduced. Applicants respectfully submit that the combination of Kitamine and Kawabata does not teach or suggest at least these features of amended claim 1.

Kitamine discloses a control device for a brushless DC motor which is able to automatically switch its operation from a start-up drive to a self-controlled drive (see col. 2, lines 8-13). This switchover to the self-controlled drive is performed when the phase difference between a driving voltage and a rotor position signal is less than a predetermined amount (see col. 2, lines 30-37).

In particular, in Kitamine, it is disclosed that when the motor reaches a predetermined speed, a signal indicating rotor position relative to the armature is generated in the armature

(see col. 2, lines 22-24). At the same time, a phase difference between the driving voltage and the rotor position signal is detected for a period covering more than one rotation of the rotor (see col. 2, lines 24-27). As explained in Kitamine, when the phase difference between the driving voltage and the rotor position signal is smaller than a predetermined amount, the motor is switched to the self-controlled drive (see col. 2, lines 27-37).

For example, in Kitamine, it is disclosed that a microcomputer 8 calculates a phase difference between a phase (real phase) of the rotor position signals 4u, 4v, 4w fed from a rotor position detecting circuit and a phase of the 3-phase upper and lower signals 8u-8z (i.e., the driving voltage) (see col. 5, lines 23-27). Kitamine explains that the phase of the driving voltage can either be advanced or delayed from the phase of the rotor position signals (see col. 5, lines 27-34 and col. 6, lines 20-27), and that when the phase difference between the driving voltage and the rotor position signals becomes smaller than a predetermined amount under both situations (i.e., in the advanced phase and delayed phase), the driving mode is switched from the start-up drive to the self-controlled drive (see col. 5, lines 34-37).

Based on the foregoing description of Kitamine, it is clear that the switchover from start-up drive to self-controlled drive is based on a difference in phase between a driving voltage and a rotor position signal. In particular, in Kitamine, the advancement and delay of the phase of the driving voltage with respect to the phase of the rotor position signal is used to determine when the switchover from start-up drive to self-controlled drive will take place.

Thus, while Kitamine discloses that a relationship between the phase of the driving voltage and the phase of the rotor position signal is utilized to determine when to switch to a self-controlled mode, Applicants respectfully submit that there is absolutely no disclosure whatsoever in Kitamine regarding a relationship between the phase of the induction voltage and a phase of the current.

As noted above, claim 1 has been amended to recite that during a start-up mode, a phase of the current is advanced with respect to a phase of the induction voltage in order to obtain sufficient torque to start driving the dc brush-less motor, and that immediately after the start-up mode is complete, the advancement of the phase of the current with respect to the phase of the induction voltage is reduced.

Thus, according to claim 1, there is a relationship between the phase of the current and the phase of the induction voltage; namely, that the phrase of the current is advanced with respect to the phase of the induction voltage in order to obtain sufficient torque to start driving the dc brush-less motor, and that after the start-up mode is complete, the advancement of the phase of the current with respect to the phase of the induction voltage is reduced. Applicants respectfully submit that Kitamine does not disclose or even remotely suggest such features.

In particular, as noted above, Kitamine merely indicates that a relationship between the phase of the driving voltage and the phase of the rotor position signal is used to determine when to switch to a self-controlled mode.

In addition, Applicants respectfully submit that Kawabata does not cure the deficiencies of Kitamine. In this regard, Applicants note that Kawabata merely discloses the use of a brushless motor having three-phase coils connected in a delta shape, wherein it is indicated in Kawabata that this type of motor has superior characteristics to those of a conventional Y-connection three-phase brushless motor (see col. 1, lines 43-54).

In view of the foregoing, Applicants respectfully submit that the combination of Kitamine and Kawabata does not disclose, suggest or otherwise render obvious all of the features recited in amended claim 1. Accordingly, Applicants submit that claim 1 is patentable over the cited prior art, an indication of which is kindly requested.

Regarding claims 2, 4, 5 and 11, Applicants note that these claims depend from claim 1 and are therefore considered patentable at least by virtue of their dependency.

In addition, regarding claim 2, Applicants note that this claim has been amended to recite that the start-up mode of driving the dc brush-less motor is determined to be complete when a first predetermined length of time passes after the start of driving the dc brush-less motor, or when the dc brush-less motor reaches a first predetermined amount of revolutions per minute (rpm). Applicants respectfully submit that the combination of Kitamine and Kawabata does not teach or suggest such features.

Regarding Kitamine, as noted above, Kitamine discloses that the switch from the start-up drive mode to the self-controlled drive mode takes place when the phase difference between the driving voltage and the rotor position signal is determined to be less than a predetermined amount.

Accordingly, in Kitamine, as the difference in phase between the driving voltage and the rotor position signal is used to determine the end of the start-up drive mode, Applicants respectfully submit that Kitamine does not disclose that the start-up mode of driving a dc brush-less motor is determined to be complete when a first predetermined length of time passes after the start of driving the dc brush-less motor, or when the dc brush-less motor reaches a first predetermined amount of revolutions per minute (rpm), as recited in amended claim 2. In addition, Applicants respectfully submit that Kawabata does not cure this deficiency of Kitamine.

Accordingly, Applicants respectfully submit that claim 2 is patentable over the combination of Kitamine and Kawabata, an indication of which is kindly requested.

Further, regarding claim 4, Applicants note that this claim recites that the driver determines a position of the rotor magnet by detecting a current flowing through the stator

winding and by calculating the induction voltage based on the detected current. Applicants respectfully submit that the combination of Kitamine and Kawabata does not teach or suggest such a feature.

In the Office Action, Applicants note that the Examiner indicates that the rotor position detecting circuit 4 of Kitamine determines a position of the rotor by detecting a current flowing the stator winding. Applicants respectfully point out, however, that the rotor position detecting circuit 4 of Kitamine, does not determine a position of the rotor by detecting a current flowing through the stator winding, but instead, determines a position of the rotor based on voltage.

For example, at col. 4, lines 8-13, Kitamine discloses that the "rotor position detecting circuit 4 is composed of three filter circuits (not shown) which detect low frequency components in the 3-phase driving voltage supplied from the inverter 2 to the motor 1 and three comparators (not shown) which convert the low frequency components into rotor position signals 4u, 4v, 4w" (emphasis added).

Thus, based on the foregoing description, Applicants respectfully submit that the rotor position detecting circuit of Kitamine detects the rotor position based on voltage, not on current. In addition, Applicants respectfully submit that Kawabata does not cure this deficiency of Kitamine.

Accordingly, Applicants submit that claim 4 is patentable over the cited prior art, an indication of which is kindly requested.

Further, regarding claim 11, Applicants note that this claim has been amended to recite that the start-up mode of driving the dc brush-less motor is determined to be complete when a first predetermined length of time passes after the start of driving the dc brush-less motor.

Applicants respectfully submit that the combination of Kitamine and Kawabata does not teach or suggest such a feature.

As explained above with respect to claim 2, Kitamine discloses that the switch from the start-up drive mode to the self-controlled drive mode takes place when phase difference between the driving voltage and the rotor position signal is determined to be less than a predetermined amount.

Accordingly, in Kitamine, as the difference in phase between the driving voltage and the rotor position signal is used to determine the end of the start-up drive mode, Applicants respectfully submit that Kitamine does not disclose that the start-up mode of driving a dc brush-less motor is determined to be complete when a first predetermined length of time passes after the start of driving the dc brush-less motor, as recited in amended claim 11. In addition, Applicants respectfully submit that Kawabata does not cure this deficiency of Kitamine.

Accordingly, Applicants respectfully submit that claim 11 is patentable over the combination of Kitamine and Kawabata, an indication of which is kindly requested.

B. In items 3 and 4 on pages 3-4 of the Office Action, the Examiner has rejected claims 3 and 8 under 35 U.S.C. § 103(a) as being unpatentable over Kitamine et al. in view of Kawabata and Heeren et al (U.S. 6,078,158).

Regarding claim 3, Applicants note that this claim depends from claim 1. Applicants respectfully submit that Heeren fails to cure the deficiencies of Kitamine and Kawabata, as discussed above, with respect to claim 1. Accordingly, Applicants submit that claim 3 is patentable at least by virtue of its dependency.

In addition, Applicants note that claim 3 recites that the driver draws instantaneous maximum torque of the dc brush-less motor depending on the advancement of the phase of the current of the winding with respect to the phase of the induction voltage generated in the winding. Applicants respectfully submit that the combination of Kitamine, Kawabata and Heeren does not teach or suggest the above noted feature recited in claim 3.

In the Office Action, the Examiner asserts that Heeren discloses "phase advancement at startup to generate maximum torque."

Applicants note, however, that in Heeren, it is disclosed that commutation phase advance is controlled to generate substantially maximum torque if the detected environmental temperature indicates that maximum torque is needed (see col. 3, lines 10-12). For example, it is noted that Fig. 7 of Hereen is a representation of the effects of phase advance on the maximum achievable torque and current for a motor (see col. 9, lines 36-38). As shown in Fig. 7 of Hereen, torque is increased by increasing the current.

Thus, while Heeren discloses that torque can be increased by increasing current, Applicants respectfully submit that Heeren does not disclose or suggest that the torque can be increased by controlling the phase as in the present invention (e.g., see Figs. 13-16 of the present application).

In view of the foregoing, Applicants respectfully submit that Hereen does not disclose, suggest or otherwise render obvious that maximum torque is based on the advancement of the phase of the current of the winding with respect to the phase of the induction voltage generated in the winding, as recited in amended claim 3. In addition, Applicants respectfully submit that Kitamine and Kawabata do not cure this deficiency of Heeren.

Accordingly, Applicants submit that claim 3 is patentable over the cited prior art, an indication of which is kindly requested. Regarding claim 8, as noted above, this claim has been canceled by this amendment.

C. In item 12 on page 5 of the Office Action, the Examiner has rejected claim 12 under 35 U.S.C. § 103(a) as being unpatentable over Kitamine et al. in view of Kawabata and Shinkawa et al. (U.S. 5,780,983).

Regarding claim 12, as noted above, this claim has been canceled by this amendment. Applicants note, however, that the features recited in claim 12 have been incorporated into claim 1. In particular, Applicants note that claim 1 has been amended to recite that the dc brush-less motor is an interior permanent magnet (IPM) motor.

Regarding Shinkawa, Applicants note that while this reference discloses the use of an IPM motor, that Shinkawa does not cure the deficiencies of Kitamine and Kawabata, as discussed above, with respect to claim 1.

II. New Claims

Claims 13-21 have been added as new claims. Claims 13-21 depend from claim 1 and are therefore considered patentable at least by virtue of their dependency for the reasons discussed above.

III. Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue

which the Examiner feels may best be resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

Respectfully submitted,

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